

Seamless Integration of VDL into the NAS with the Multimode Digital Radio

by

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ICNS Conference and Workshop 2004

Fairfax, VA

NASA Glen Research Center

27 April 2004

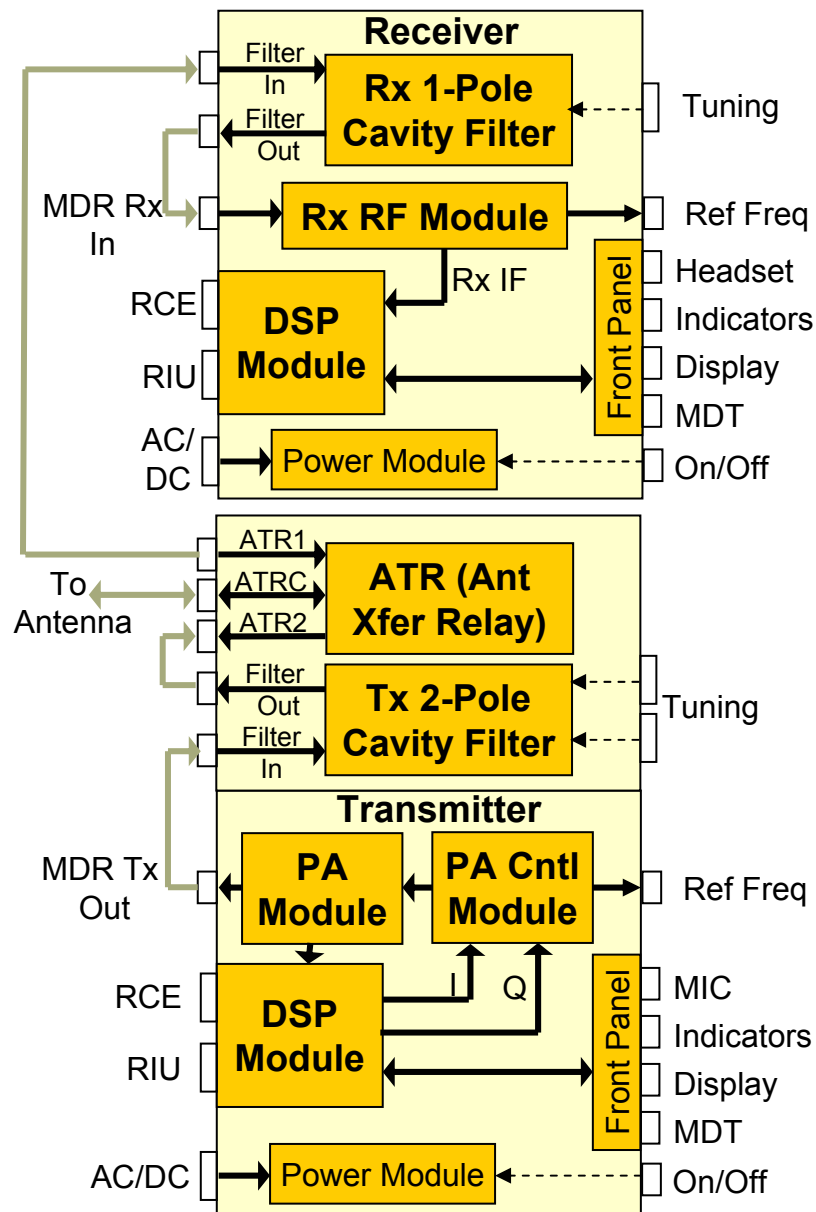
Presentation Overview

- **Multimode Digital Radio (MDR) Program Overview**
- **MDR Description**
- **DSB-AM and VDL Mode Collocation Operational Issues**
- **MDR Collocation Test Results**

MDR Program

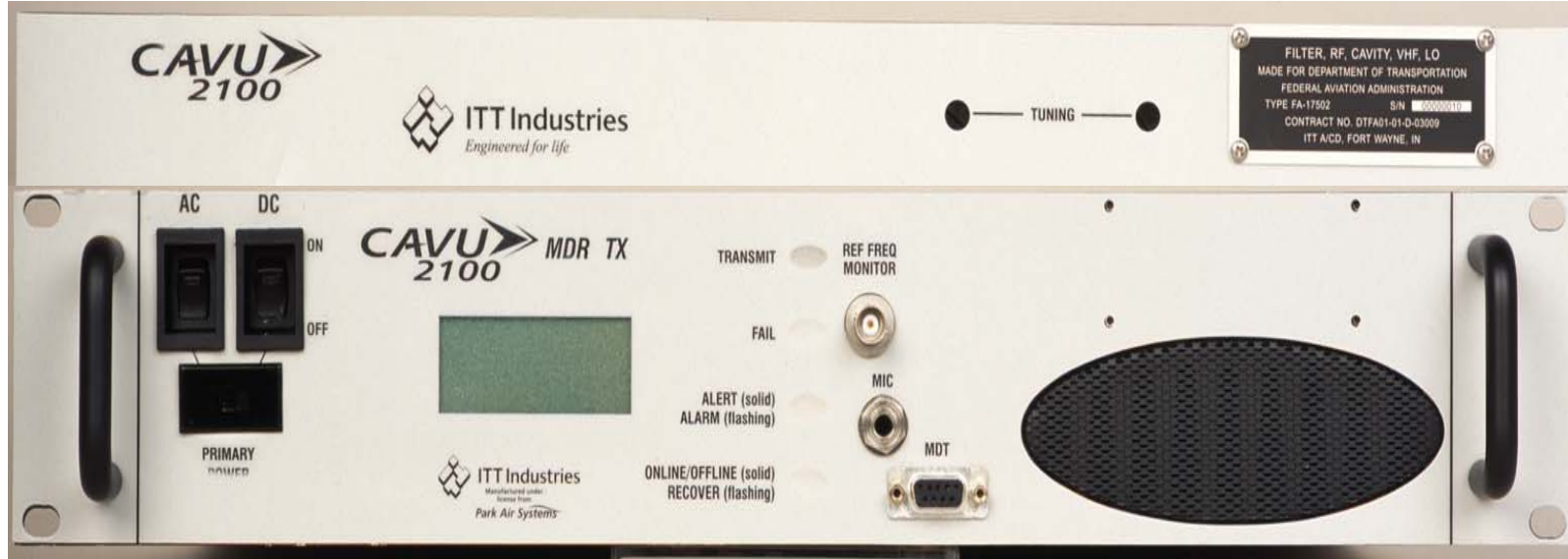
- **Program Objectives**
 - Replace legacy DSB-AM radios in service since 1960's
 - Support transition to VDL operation when deployed
- **Contract Award - July 2001**
- **Factory Acceptance Test - May 2002**
- **Key site testing at Jacksonville FL - August 2002**
- **Production Acceptance Test – September 2003**
- **RFI Testing at WJHTC – December 2003**
 - Analog on VDL Mode 3 and vice versa
 - ITT supporting test efforts with ASR
- **Operational at Jacksonville and Los Angeles ARTCC, as well as Jacksonville RTR and Gainesville FSS**
- **Contract quantity is for 37,000 MDRs over next 10-15 years**

MDR Block Diagram and Key Features



- **Multi-mode Operation**
 - 25 kHz DSB-AM
 - 8.33 kHz DSB-AM
 - VHF Data Link (VDL) Modes
- **Software-based design**
 - Digital Modulation/Demodulation
 - Fully Programmable DSP Module
- **High linearity RF Power Amplifier with Cartesian Loop**
 - Superior AM voice quality
 - Low VDL spectral sidelobes
- **Remotely tunable w/o cosite filters for nominal collocation interference**
- **Fixed tuned operation with Tx and Rx Cavity Filters for severe collocation interference**

MDR Physical Characteristics



1U
1.75 Inch
Filter
Chassis

2U
3.5 Inch
19 inch
Rack
Mounted
Chassis

MDR 15/50 Watt Transmitter & Transmit Cavity Filter



2U
3.5 Inch
19 inch
Rack
Mounted
Chassis

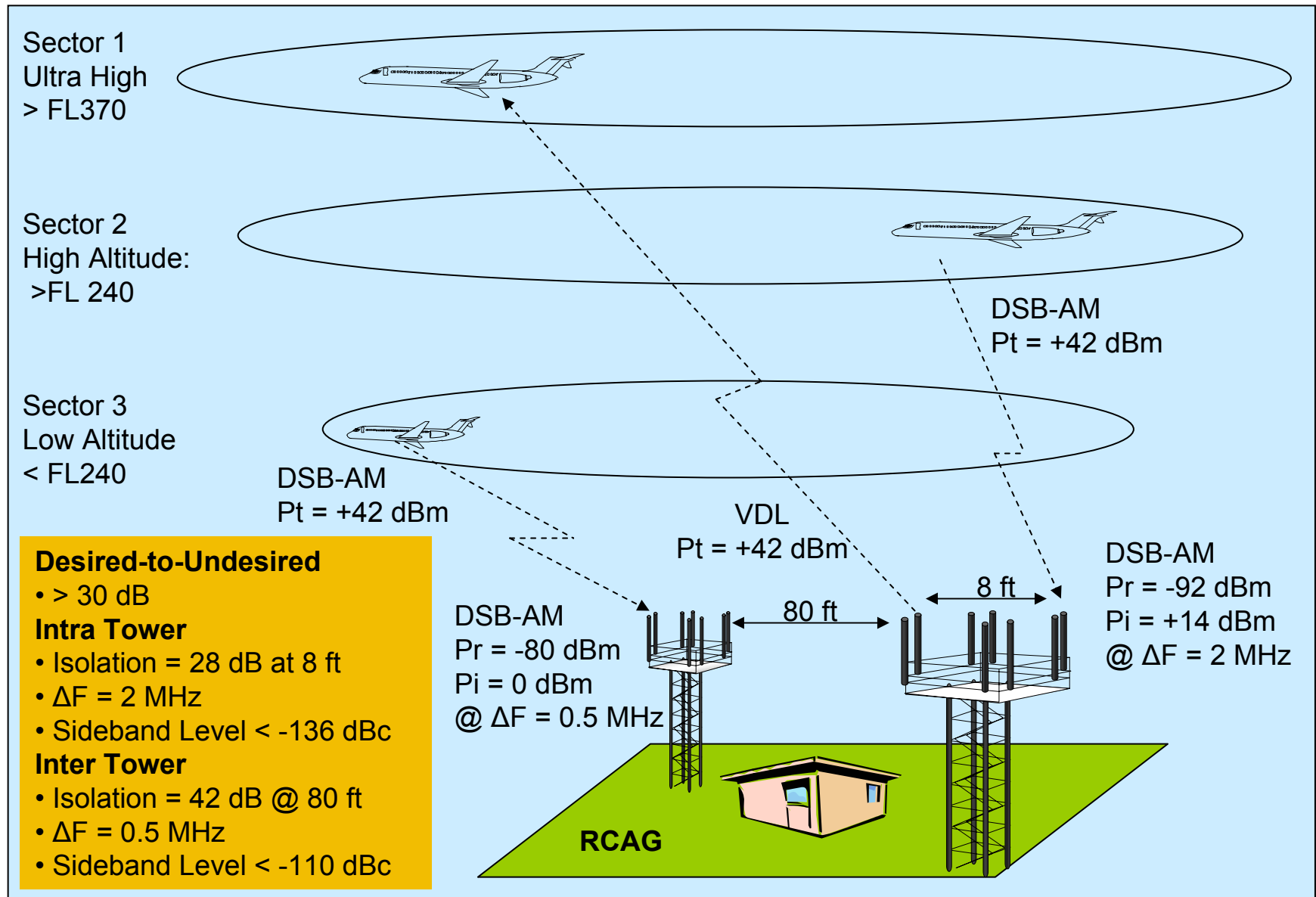
MDR Receiver with Built-in Cavity Filter

Direct physical replacement for existing DSB-AM Radios

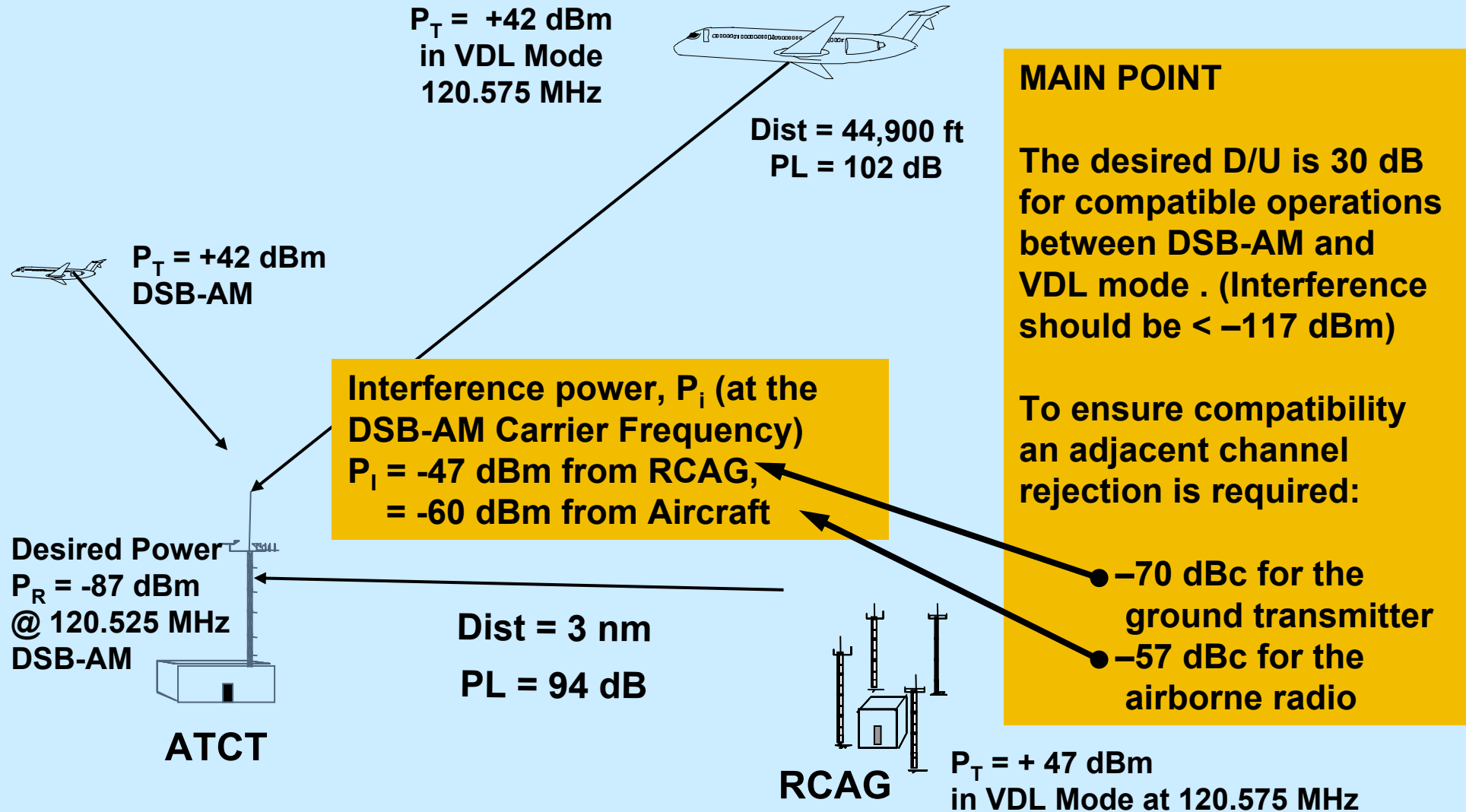
Key MDR Performance Characteristics

| <u>Parameter</u> | <u>Requirement</u> | <u>Measured Data</u> |
|------------------|-----------------------------------|----------------------|
| Rcv Sensitivity | | |
| DSB-AM | > 10 dB SINAD @ -102 dBm | 19 dB SINAD |
| VDL | < 10 ⁻³ BER @ -100 dBm | 0 BER |
| Tx Power | | |
| Hi Power | 10 to 50 Watts in 0.5 dB steps | |
| Lo Power | 2 to 15 Watts in 0.5 dB steps | |
| Tx Distortion | | |
| DSB-AM | < 5% at 90% AM Mod Index | < 1% |
| VDL | EVM < 5% | < 2.5% |

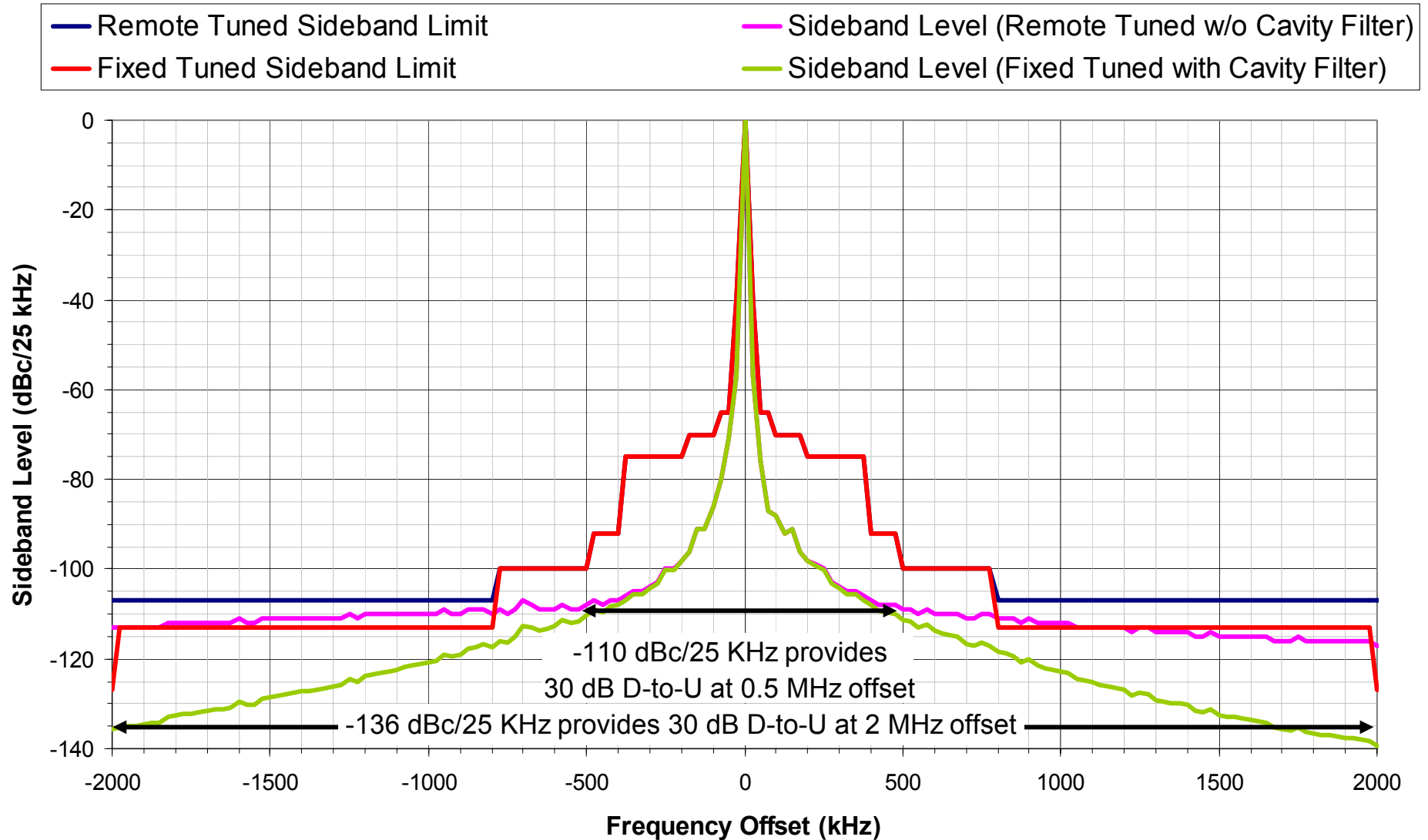
DSB-AM and VDL Cosite Scenario



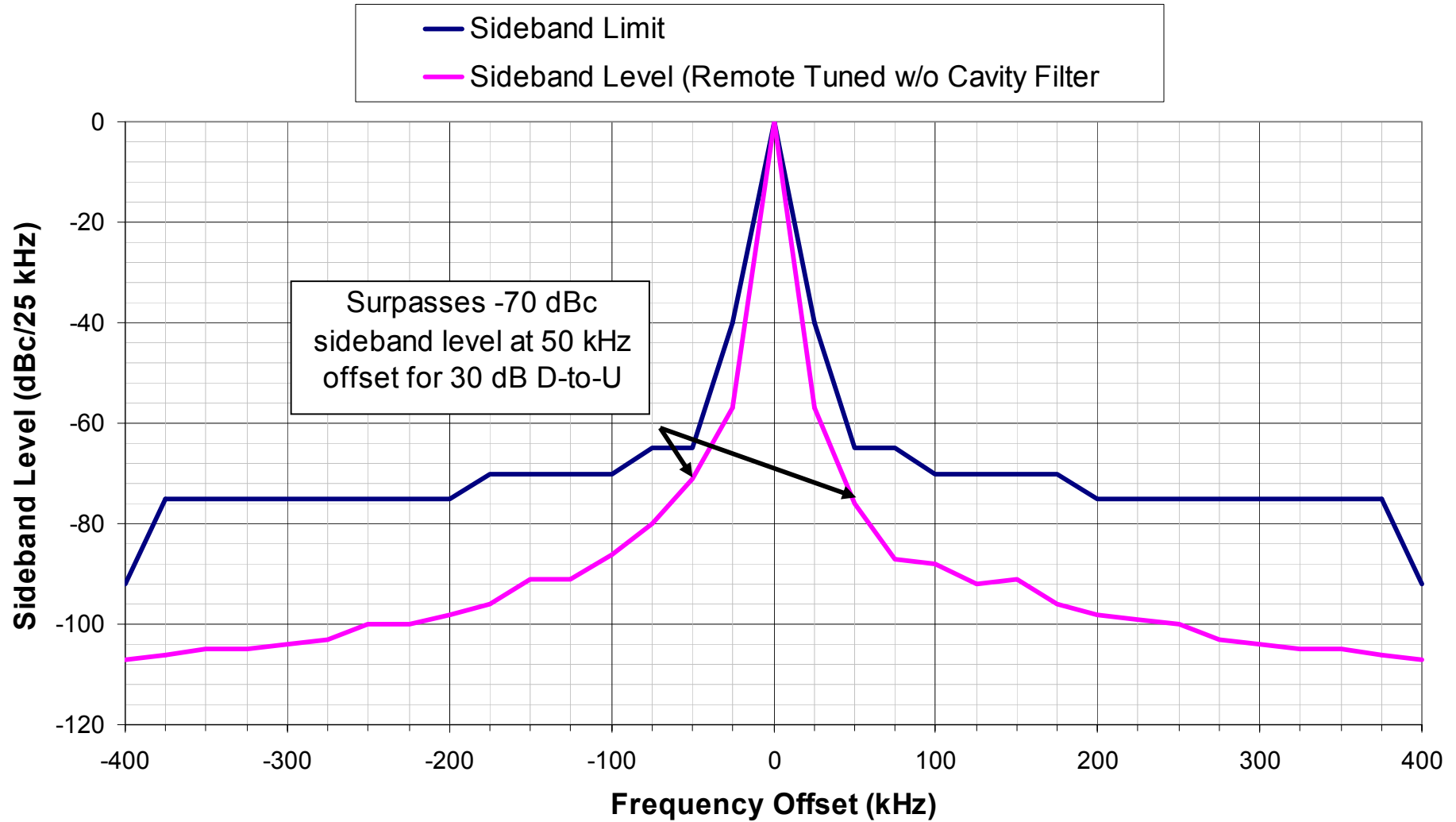
DSB-AM and VDL Collocation Scenario



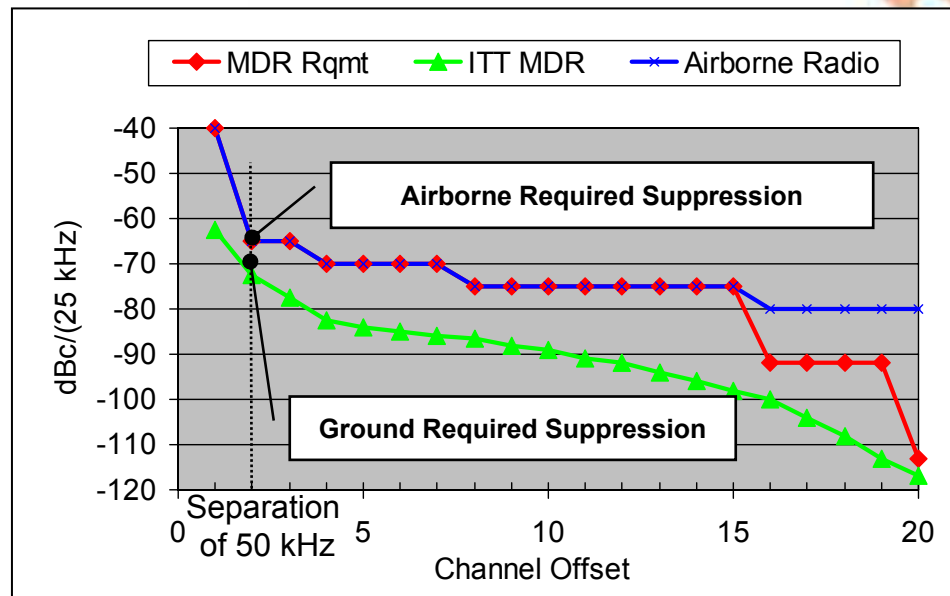
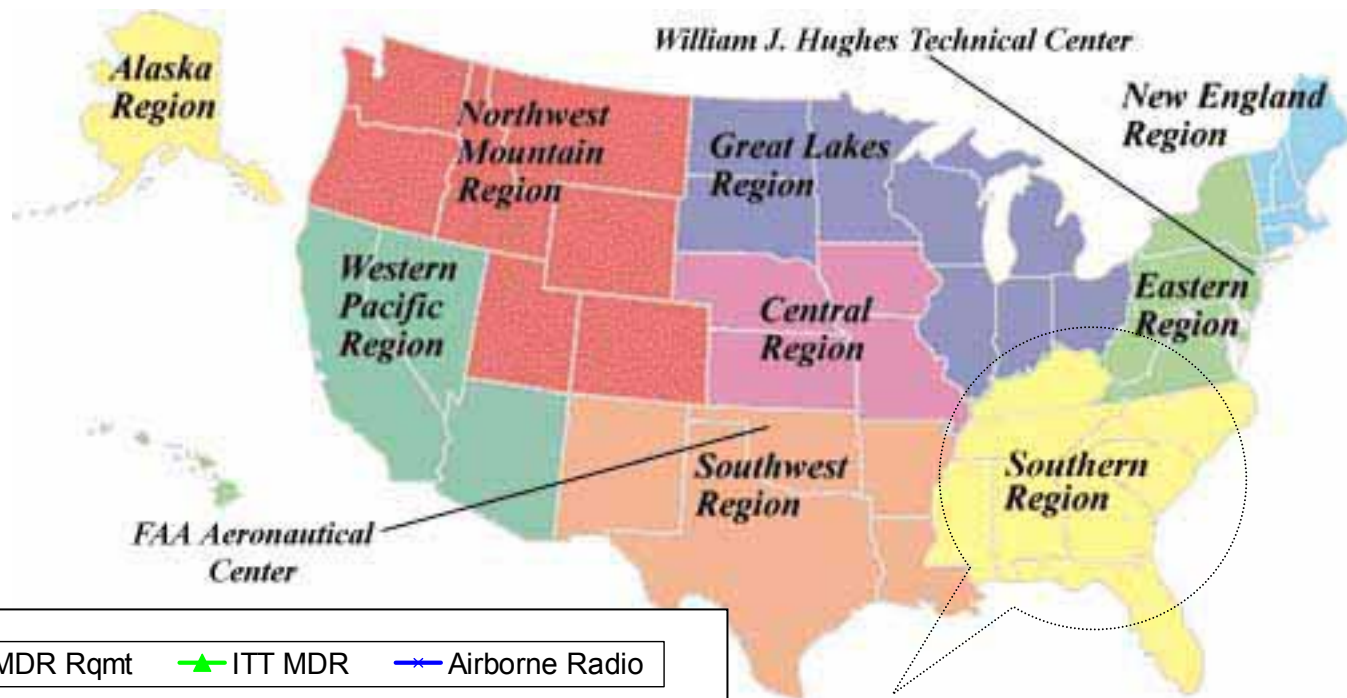
MDR Transmit Spectrum meets Cosite Sideband Limits



MDR meets Collocation Sideband Limits



Benefits of MDR Superior Collocation Performance



Southern Region Simulation Results

- 30 dB desired-to-undesired required
- MDR is a drop-in solution with only one frequency re-planned for VDL Mode at 50 kHz offset and -72 dBc/Hz
- 227 required frequency reassignments required if radio only provides -65 dBc/25 kHz at 50 kHz offset

Summary and Conclusions

- **MDR is in production at ITT and being fielded by FAA**
- **Multi-mode capability supports transition from 25 kHz DSB-AM operation to 8.33 kHz or VDL**
- **Superior performance eliminates cosite and collocation issues as a concern for the deployment of VDL operation within the NAS**
- **Programmable architecture supports implementation of VDL and new modes as they emerge**